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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/081,074	02/21/2002	Sergey Lopatin	P1406	2324

7590

04/09/2003

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EXAMINER

FOONG, SUK SAN

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 04/09/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/081,074	LOPATIN, SERGEY	
	Examiner	Art Unit	
	Suk-San Foong	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 11-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 2/21/02 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s) ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>2</u> . | 6) <input type="checkbox"/> Other: |

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DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of Group I, claim 1-10, in Paper No. 6 is acknowledged. The traversal is on the ground that the device claims are related to the process. This is not found persuasive because fields of search for the invention of Group I and Group II are not co-extensive which is an evidence of serious burden and applicants have not provide a convincing argument that the alternative method stated in the office action mailed 2/27/03 would not be capable of providing the device of Group II.

The requirement is still deemed proper and is therefore made FINAL

Drawings

The drawings are objected to because it appears that some texts are missing in Figures 2 and 3. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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3. Claims 1-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

4. Claim 1, lines 9-10, it question what is recited through “completing formation of the semiconductor device”. It is suggested that “; and completing formation of the semiconductor device” should be deleted.

5. Claim 1, lines 2 and 7-9, it is questioned what is recited through the term “thin”.

6. Claim 3, line 3, claim 5, line 3, claim 6, line 3 and claim 7, line 3, it appears that “essentially” should be deleted.

7. Claim 4 recites the limitation "the volume" in line 3. There is insufficient antecedent basis for this limitation in the claim.

8. Claim 9, line 7, it appears that “GN₂” should be replaced by--N₂--.

9. Claim 10 recites the limitation "the volume of water" in 16. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

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10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

11. Claims 1-10 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by Lopatin et al. ('368)

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C.

102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention “by another,” or by an appropriate showing under 37 CFR 1.131.

See Col. 7, line 62 to Col. 9, lines 12.

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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13. Claims 1, 4-6, 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alling et al. ('847) in combination with Mahneke ('926) and Kowalski ('635).

Alling et al. teaches a method of forming a semiconductor device having an electroplated layer of copper alloy over a copper layer by immersion in a chemical solution which includes providing the chemical solution (¶[0021,0022]), then providing a semiconductor substrate (¶[0018, 0053]) having a copper surface (¶[0023]) formed by an electroplating process (¶[0013, 0023, 0049]), and subsequently electroplating the copper surface in the chemical solution to form a copper-zinc alloy on the copper surface (¶[0027, 0029]) by immersing the copper surface for a defined period ranging from 0.25 seconds to 60 or more seconds wherein the duration dictates the thickness of the electroplating layer (¶[0050]), for example, having a thickness range of between 20nm to 0.5 microns (¶[0051]). The chemical solution is aqueous and includes at least one copper ion source for providing a plurality of copper ions comprised of at least one copper salt such as copper acetate and copper sulfate (¶[0024, 0025]) in a concentration range of about 10 to 300 g/L, at least second metal ion source such as zinc (¶[0027, 0029]), and other additives such as suppressors agents, leveling agents and etc. (¶[0032, 0039]); wherein the chemical solution is admixed with a volume of water (¶[0057]). These additives include complexing agents such as edetic acid (EDTA) and tartaric acid, and wetting agent such as polyethylene glycol (¶[0042]). Furthermore, the chemical solution is maintained at a temperature in the range of at about room temperature (i.e. 20 to 25°C) to 65°C (¶[0049]) with a pH of from about 4 to 9 (¶[0031]).

Note that the disclosed concentration range of copper ion source overlaps the recited range (see MPEP 2144.05).

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Note that the disclosed temperature range of the chemical solution overlaps the recited range (see MPEP 2144.05).

Note that the disclosed time duration for immersing the copper surface overlaps the recited range (see MPEP 2144.05).

Note that the disclosed that the thickness of copper-zinc alloy film overlaps the recited range (see MPEP 2144.05).

In regard to claim 4 and claim 6, the step recited in lines 7-8 and 6-7, respectively, would be obtained as the same materials are being treated the same as the instant invention.

Alling et al. does not disclose ^{rinsing}~~rinsing~~ the copper-zinc alloy thin film in a solvent as recited in claim 1, line 8.

Alling et al. does not disclose drying the copper-zinc alloy thin film under a gaseous flow as recited in claim 1, line 9.

Mahneke discloses an electroplating process for depositing metal or metal alloy layer on semiconductor wafers (Col. 4, line 60 to Col. 5, line 1), then rinsing the formed metal or metal alloy layer (Col. 1, lines 35-38 and Col. 5, lines 17-23), and subsequently drying the semiconductor wafers under a gaseous flow of nitrogen gas (Col. 5, lines 29-35).

It would have been within the scope to one ordinary skill in the art to combine the teachings of Mahneke with the combination process because it would enable formation of copper-zinc alloy film of Alling et al. to be performed and obtain further advantage of preventing contamination on both surfaces of the wafers (Mahneke, Col. 1, lines 36-37).

The combination process does not disclose that the chemical solution includes deionized water.

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Kowalski teaches a method for electroplating copper-zinc alloys (Col. 3, lines 53-56) on substrate by providing a chemical solution that is aqueous comprised of metal ions of copper and zinc with its respective metal salts (Col. 3, lines 30-37, Col. 6, lines 21-30) and complexing agents or chelating such as EDTMP (ethylenediamine tetra(methdylene phosphonate) ligand and HEDP; wherein the metal ions and complexing agents are dissolved in water such as deionized water (Col. 6, lines 53-58 and Col. 10, lines 14-21).

It would have been within the scope to one ordinary skill in the art to combine the teachings of Kowalski with the combination process because it would enable admixing the chemical solution with a volume of water of the combination to be performed.

14. Claims 2, 3, 7 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alling et al. ('847) in combination with Mahneke ('926) and Kowalski ('635) as applied to claims 1, 4-6, 8 and 9 above, and further in view of Krishnamoorthy et al. ('533).

The combination process does not disclose that at least one zinc ion source is comprised of at least one zinc salt selected from a group as recited in claim 3, lines 3-8.

The combination process does not disclose that at least one pH adjuster comprised of at least one pH-adjusting compound selected from NH_4OH or TMAH as recited in claim 7.

The combination process does not disclose that the zinc content in copper-zinc alloy layer 40 is in a concentration range of less than 1 atomic %.

Krishnamoorthy et al. discloses an electroplating process for depositing copper-zinc alloy in fabrication of semiconductor device which includes providing semiconductor substrate 30 (Col. 4, lines 4-7, and Fig. 1), then providing bonding layer 35 comprised of material such as

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copper layer (Col. 4, lines 30-32, 48-50, 62-64) by PVD, CVD or electroplating method (Col. 5, lines 4-9), then providing chemical solution which includes at least one zinc ion source comprised of zinc sulfate in a concentration range of about 10 to 40 g/L, copper ion source such as copper sulfate in a concentration range of about 5 to 20 g/L (Col. 6, lines 35-37, and Table 1), chemicals that would bring the disparate deposition potentials proximate one another so that metals can be co-deposited such as ³complexing agents comprised of ethylenediamine (EDA), EDTA, cyanide and etc. in a concentration range of about 20 to 40 g/L (Col. 6, lines 45-50), additional agent such as wetting agent (Table 1) and a pH adjuster such as NH_4OH (ammonium hydroxide) for maintaining the solution between pH level in a range of about 8 to about 11 (Table 1), subsequently electroplating copper-zinc alloy layer 40 onto substrate 30 with bonding layer 35 using the chemical solution (Col. 6, lines 62-67) wherein the zinc concentration in copper-zinc alloy layer 40 is in a range of less than 1 atomic %, and then performing other processes typically associated with electroplating such as rinsing (Col. 9, lines 33-36).

It would have been within the scope to one ordinary skill in the art to combine both teachings because it would enable formation of the chemical solution of the combination process to be performed and obtain further advantage of solving the diffusion and self-passivation problems in metallization structure (Krishnamoorthy et al., Col. 3, lines 1-5).

Note that the disclosed zinc concentration in the copper-zinc alloy film overlaps the recited range (see MPEP 2144.05).

Note that the disclosed concentration range for the complexing agents overlaps the recited range (see MPEP 2144.05).

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One of ordinary skill in the art would have been motivated to arrive at selected concentration range for the pH adjuster for use in the process of the combination through routine experimentation depending on the desired reaction rate because chemical concentration is recognized to be a result effective variable.

One of ordinary skill in the art would have been motivated to arrive at selected concentration range for the wetting agent for use in the process of the combination through routine experimentation depending on the desired reaction rate because chemical concentration is recognized to be a result effective variable. Furthermore, Alling et al. suggests at ¶[0045], last two sentences, that a concentration range of 0.1 to 20 g/L for the wetting agent as a suitable composition for tin. The disclosed range overlaps the recited range.

One of ordinary skill in the art would have been motivated to arrive at selected volume range for use in the process of the combination through routine experimentation depending on the desired device dimension and device characteristics.

Conclusion


15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. 3,919,056 teaches an electroplating zinc solution comprised of zinc salts and complexing agent such as hydroxycarboxylic acid, EDTA and etc. to prevent the precipitation of zinc from the solution. 4,904,354 discloses method for electrodeposition of copper-zinc alloy wherein hydroxycarboxylic acid is comprised of tartaric acid is a chelating or complexing agent to be used in the electroplating chemical solution.


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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Suk-San Foong whose telephone number is 703-305-0383. The examiner can normally be reached on Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 (7724, 3431, 3432).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


April 1, 2003


George Fourson
Primary Examiner
Art Unit 2823